National Semiconductor

January 1995

LM341, LM78MXX Series 3-Terminal Positive Voltage Regulators

General Description

The LM341 and LM78MXX series of three-terminal positive voltage regulators employ built-in current limiting, thermal shutdown, and safe-operating area protection which makes them virtually immune to damage from output overloads.

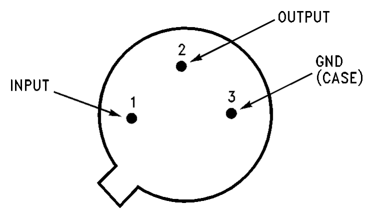
With adequate heatsinking, they can deliver in excess of 0.5A output current. Typical applications would include local (on-card) regulators which can eliminate the noise and degraded performance associated with single-point regulation.

Features

- Output current in excess of 0.5A
- No external components
- Internal thermal overload protection
- Internal short circuit current-limiting
- Output transistor safe-area compensation
- Available in TO-220 and TO-39 packages
- Output voltages of 5V, 12V, and 15V

Connection Diagrams

TO-39 Metal Can Package (H)

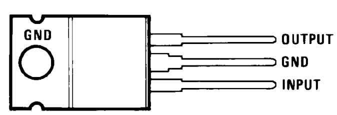


TL/H/10484–5

Bottom View

Order Number LM78M05CH, LM78M12CH or LM78M15CH
See NS Package Number H03A

TO-220 Power Package (T)



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Top View

Order Number LM341T-5.0, LM341T-12 or LM341T-15
See NS Package Number T03B

Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

Lead Temperature (Soldering, 10 seconds)	
TO-39 Package (H)	300°C
TO-220 Package (T)	260°C
Storage Temperature Range	−65°C to +150°C
Operating Junction Temperature Range	−40°C to +125°C
Power Dissipation (Note 2)	Internally Limited
Input Voltage	
$5V \leq V_O \leq 15V$	35V
ESD Susceptibility	TBD

Electrical Characteristics

Limits in standard typeface are for $T_J = 25°C$, and limits in **boldface type** apply over the −40°C to +125°C operating temperature range. Limits are guaranteed by production testing or correlation techniques using standard Statistical Quality Control (SQC) methods.

LM341-5.0, LM78M05C Unless otherwise specified: $V_{IN} = 10V$, $C_{IN} = 0.33\ \mu F$, $C_O = 0.1\ \mu F$

Symbol	Parameter	Conditions		Min	Typ	Max	Units
V_O	Output Voltage	$I_L = 500$ mA		4.8	5.0	5.2	V
		$5\ mA \leq I_L \leq 500\ mA$ $P_D \leq 7.5W$, $7.5V \leq V_{IN} \leq 20V$		**4.75**	**5.0**	**5.25**	
$V_{R\ LINE}$	Line Regulation	$7.2V \leq V_{IN} \leq 25V$	$I_L = 100$ mA			50	mV
			$I_L = 500$ mA			100	
$V_{R\ LOAD}$	Load Regulation	$5\ mA \leq I_L \leq 500\ mA$				100	
I_Q	Quiescent Current	$I_L = 500$ mA			4	10.0	mA
ΔI_Q	Quiescent Current Change	$5\ mA \leq I_L \leq 500\ mA$				0.5	
		$7.5V \leq V_{IN} \leq 25V$, $I_L = 500$ mA				1.0	
V_n	Output Noise Voltage	f = 10 Hz to 100 kHz			40		µV
$\frac{\Delta V_{IN}}{\Delta V_O}$	Ripple Rejection	f = 120 Hz, $I_L = 500$ mA			78		dB
V_{IN}	Input Voltage Required to Maintain Line Regulation	$I_L = 500$ mA		7.2			V
ΔV_O	Long Term Stability	$I_L = 500$ mA				**20**	mV/khrs

Electrical Characteristics

Limits in standard typeface are for $T_J = 25°C$, and limits in **boldface type** apply over the $-40°C$ to $+125°C$ operating temperature range. Limits are guaranteed by production testing or correlation techniques using standard Statistical Quality Control (SQC) methods. (Continued)

LM341-12, LM78M12C Unless otherwise specified: $V_{IN} = 19V$, $C_{IN} = 0.33\ \mu F$, $C_O = 0.1\ \mu F$

Symbol	Parameter	Conditions		Min	Typ	Max	Units
V_O	Output Voltage	$I_L = 500$ mA		11.5	12	12.5	V
		$5\ mA \leq I_L \leq 500\ mA$ $P_D \leq 7.5W$, $14.8V \leq V_{IN} \leq 27V$		**11.4**	**12**	**12.6**	
$V_{R\ LINE}$	Line Regulation	$14.5V \leq V_{IN} \leq 30V$	$I_L = 100$ mA			120	mV
			$I_L = 500$ mA			240	
$V_{R\ LOAD}$	Load Regulation	$5\ mA \leq I_L \leq 500\ mA$				240	
I_Q	Quiescent Current	$I_L = 500$ mA			4	10.0	mA
ΔI_Q	Quiescent Current Change	$5\ mA \leq I_L \leq 500\ mA$				0.5	
		$14.8V \leq V_{IN} \leq 30V$, $I_L = 500$ mA				1.0	
V_n	Output Noise Voltage	f = 10 Hz to 100 kHz			75		μV
$\frac{\Delta V_{IN}}{\Delta V_O}$	Ripple Rejection	f = 120 Hz, $I_L = 500$ mA			71		dB
V_{IN}	Input Voltage Required to Maintain Line Regulation	$I_L = 500$ mA		14.5			V
ΔV_O	Long Term Stability	$I_L = 500$ mA				**48**	mV/khrs

LM341-15, LM78M15C Unless otherwise specified: $V_{IN} = 23V$, $C_{IN} = 0.33\ \mu F$, $C_O = 0.1\ \mu F$

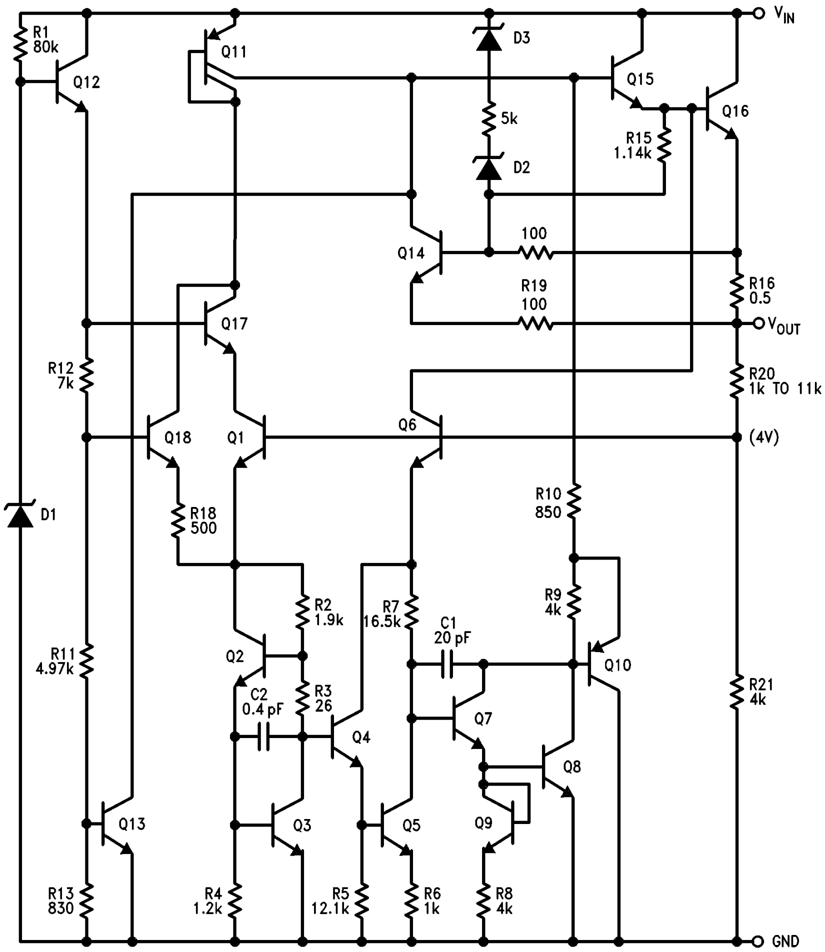
Symbol	Parameter	Conditions		Min	Typ	Max	Units
V_O	Output Voltage	$I_L = 500$ mA		14.4	15	15.6	V
		$5\ mA \leq I_L \leq 500\ mA$ $P_D \leq 7.5W$, $18V \leq V_{IN} \leq 30V$		**14.25**	**15**	**15.75**	
$V_{R\ LINE}$	Line Regulation	$17.6V \leq V_{IN} \leq 30V$	$I_L = 100$ mA			150	mV
			$I_L = 500$ mA			300	
$V_{R\ LOAD}$	Load Regulation	$5\ mA \leq I_L \leq 500\ mA$				300	
I_Q	Quiescent Current	$I_L = 500$ mA			4	10.0	mA
ΔI_Q	Quiescent Current Change	$5\ mA \leq I_L \leq 500\ mA$				0.5	
		$18V \leq V_{IN} \leq 30V$, $I_L = 500$ mA				1.0	
V_n	Output Noise Voltage	f = 10 Hz to 100 kHz			90		μV
$\frac{\Delta V_{IN}}{\Delta V_O}$	Ripple Rejection	f = 120 Hz, $I_L = 500$ mA			69		dB
V_{IN}	Input Voltage Required to Maintain Line Regulation	$I_L = 500$ mA		17.6			V
ΔV_O	Long Term Stability	$I_L = 500$ mA				**60**	mV/khrs

Note 1: Absolute maximum ratings indicate limits beyond which damage to the component may occur. Electrical specifications do not apply when operating the device outside of its rated operating conditions.

Note 2: The typical thermal resistance of the three package types is:

T (TO-220) package: $\theta_{(J-A)} = 60\ °C/W$, $\theta_{(J-C)} = 5\ °C/W$
H (TO-39) package: $\theta_{(J-A)} = 120\ °C/W$, $\theta_{(J-C)} = 18\ °C/W$

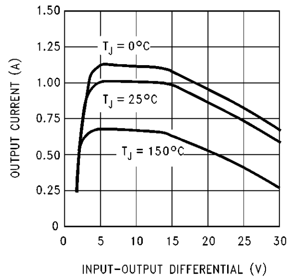
Schematic Diagram



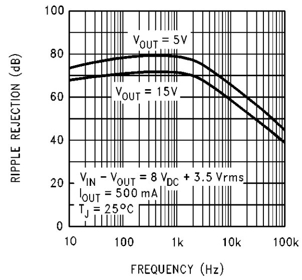
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Typical Performance Characteristics

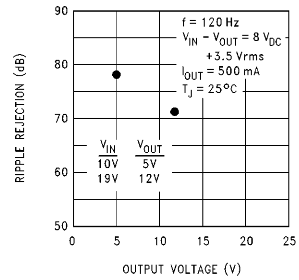
Peak Output Current



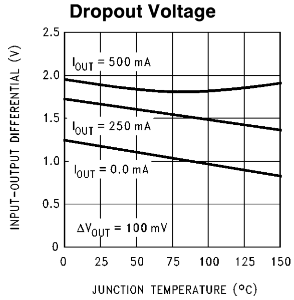
Ripple Rejection



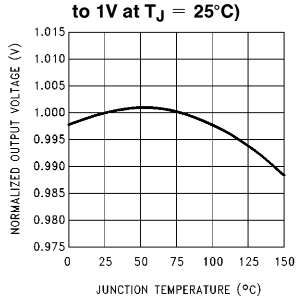
Ripple Rejection



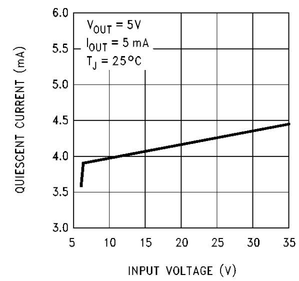
Dropout Voltage



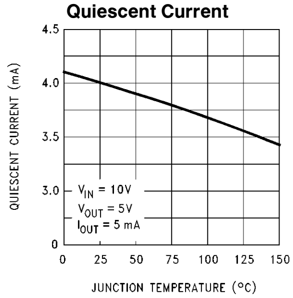
Output Voltage (Normalized to 1V at $T_J = 25°C$)



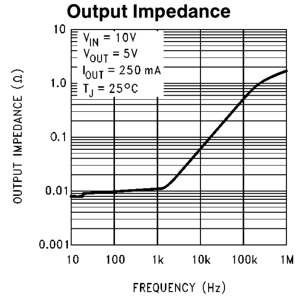
Quiescent Current



Quiescent Current



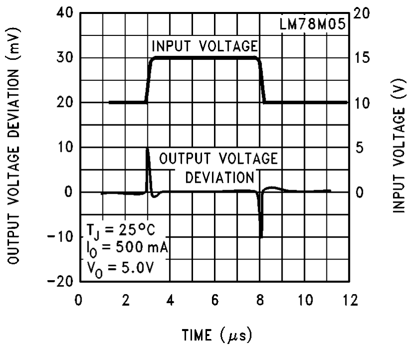
Output Impedance



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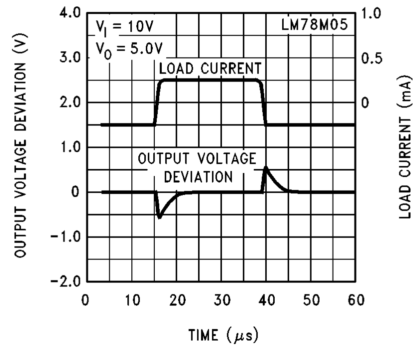
Typical Performance Characteristics (Continued)

Line Transient Response



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Load Transient Response



TL/H/10484–8

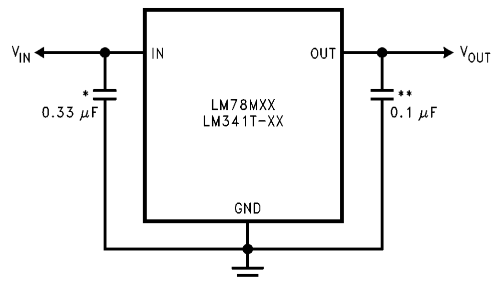
Design Considerations

The LM78MXX/LM341XX fixed voltage regulator series has built-in thermal overload protection which prevents the device from being damaged due to excessive junction temperature.

The regulators also contain internal short-circuit protection which limits the maximum output current, and safe-area protection for the pass transistor which reduces the short-circuit current as the voltage across the pass transistor is increased.

Although the internal power dissipation is automatically limited, the maximum junction temperature of the device must be kept below +125°C in order to meet data sheet specifications. An adequate heatsink should be provided to assure this limit is not exceeded under worst-case operating conditions (maximum input voltage and load current) if reliable performance is to be obtained.

Typical Application

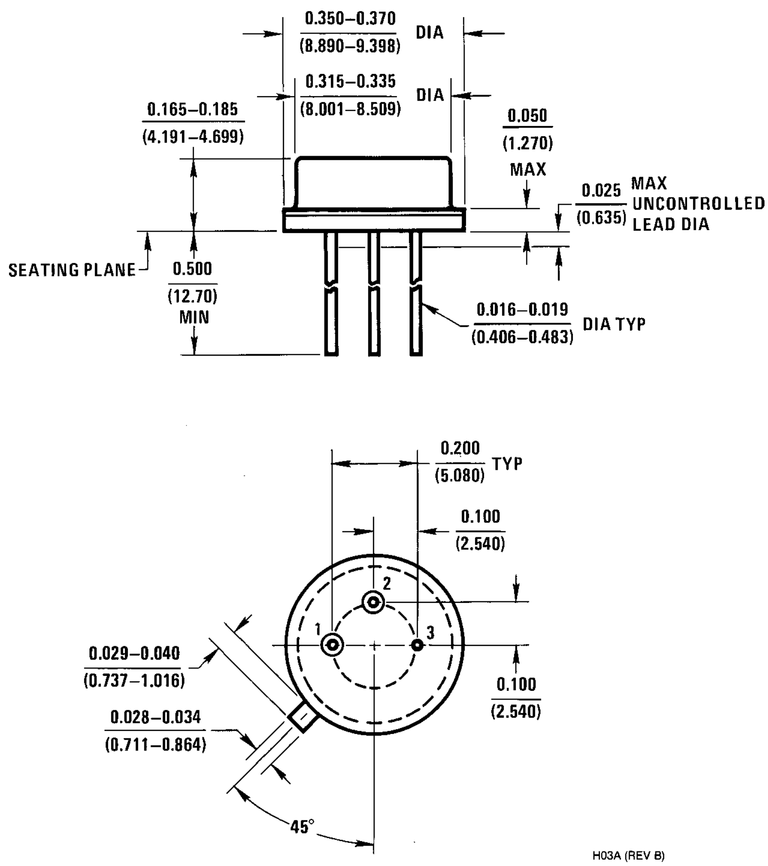


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*Required if regulator input is more than 4 inches from input filter capacitor (or if no input filter capacitor is used).

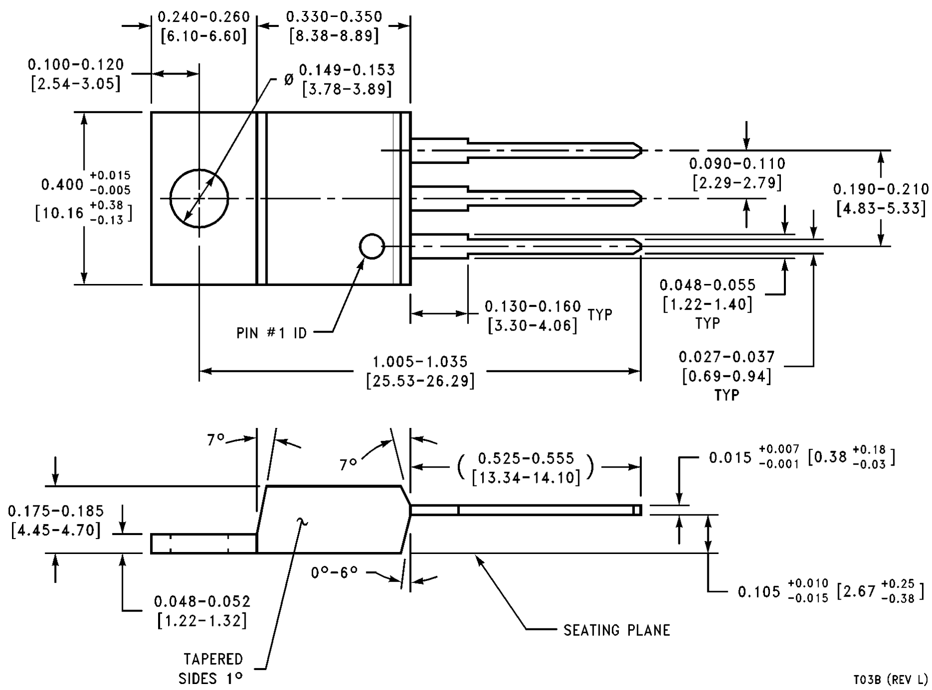
**Optional for improved transient response.

Physical Dimensions inches (millimeters)



TO-39 Metal Can Package (H)
Order Number LM78M05CH, LM78M12CH or LM78M15CH
NS Package Number H03A

Physical Dimensions inches (millimeters) (Continued)



TO-220 Power Package (T)
Order Number LM341T-5.0, LM341T-12 or LM341T-15
NS Package Number T03B

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